Product Development Team
for
NEXRAD Enhancements

Quarterly Report – 1st Quarter FY 00

00.6.1 Damaging Winds

Development and enhancement of the Damaging Downburst Detection and Prediction Algorithm (DDPDA) to ensure that it meets the aviation communities' needs for the prediction and detection of damaging winds associated with both wet and dry atmospheric environments, along with larger scale downbursts.

a) Current efforts

Work on this effort has not yet started. We are awaiting final funding, tasking, and milestones from the Operational Support Facility.

b) Planned Efforts

Overall efforts this fiscal year include finalizing the algorithm process, and then moving it into the framework of the ORPG.

c) Problems/Issues – none.
d) Interface with other organizations – none.
e) Activity schedule changes – none.

00.6.2 Polarization and Frequency Diversity

Continue development of algorithms that utilize polarization data to detect and predict the movement of the volumetric extent of hydrometeors such as hail, rain, snow, sleet, icing conditions, and freezing rain that are hazardous to aircraft.

a) Current Efforts

Activities for the first quarter of polarization development concentrated on data analysis and continued sensitivity testing of the hydrometeor classification algorithm. In particular analysis of a case collected from17 February 1999 in Brazil was begun. Two aircraft data sets were collected during this event using Cloud Particle Imaging (CPI) and High Volume Particle Sensor (HVPC) instrumentation. Software was developed to collocate reflectivity values with the HVPS data. Values computed from aircraft images are 5-10 dB low. The reason as to why this discrepancy exists is being examined.

Analysis has also continued on the 20 September 1999 aircraft icing event from the Mesoscale Alpine Programme. This was the case shown at the PMR in Norman in which the aircraft collecting the data was in a moderate icing

regime. S-POLE polarization measurements were collected in concert with the flight track. This provides an excellent case for an icing region study with particle data, S-POLE data, and *in-situ* verification collocated. Particle images have been acquired and matched to interpolated radar measurements.

An algorithm to quantitatively evaluate the sensitivity of the classified particle fields to the polarimetric variables was developed. The algorithm quantifies the sensitivity by using the concept of set theory. First, the classification set “A” (“all”) using all polarimetric variables is generated. Then, the classification set “P” (“pair”) using pairs of polarimetric variables (one is always reflectivity) is generated, and finally the classification set “R” (“rest” – excluding results from pairs) is generated. Both visual identification and quantitative analysis are conducted for these three types of classification. The relative contribution of variable pairs to hydrometer classification is quantified. For example, (PnA)/A (where "n" is for intersection) represent the % of correctly classified data using the pair only. Seven similar formulas are used in the investigation of the relative contribution of the corresponding polarimetric variable pairs. This sensitivity test also helps eliminate the gross errors in the classification scheme and fine-tune the fuzzy logic tables.

b) Planned Efforts

The main efforts throughout the next quarter will be to continue analysis of the cases discussed above and the sensitivity testing. These efforts will provide both better observational interpretation and quantitative assessment of the classification algorithm. In addition, planning of the upcoming STEPS program during July in eastern Colorado, which includes S-POLE radar deployment, is now ongoing.

c) Problems/Issues – none.
d) Interface with other organizations – none.
e) Activity schedule changes – none.

00.6.3 Circulations

Continue to enhance NSSL’s Mesocyclone Detection and Tornado Detection Algorithms (MDA, TDA) while developing in parallel a new algorithm which combines MDA and TDA into one algorithm which detects and analyzes all circulations - the Vortex Detection and Diagnosis Algorithm (VDDA).

a) Current efforts

A decision briefing was given to the OSF Directors on July 20 for consideration of MDA integration ORPG with the first possible build, or to instead continue with VDDA development. That decision is still pending but is expected in during the second quarter of FY 00.

MDA finalization is currently underway with the expectation that implementation of MDA within ORPG will occur. Additionally, software changes will be added to increase user adaptability and to integrate new findings of other work concerning vertical and time association. Work was continued work on "display mockups" to determine easy ways for the users to quickly filter the displays for weak vortex detections.

The MDA/TDA database now includes 64 cases (3 added in last quarter). There are a total of 449 tornado reports, 404 severe wind reports, containing 3977 volumes (about 400 hours) of radar data. About 150,000 MDA and 15,000 TDA detections are part of the database. Many of the more interesting storms are given an individual analysis on the following Web page:

http://www.nssl.noaa.gov/teams/swat/Cases/cases_pix.html

The entire data set was run using the current fielded 88D-Mesocyclone Algorithm for comparison purposes. Preliminary scoring was completed but will be reported in the next quarterly report.

Also tested was a "brute-force" method of varying a number of vortex detection attributes by a variety of combinations to maximize the Heidke Skill Statistic. The method will be a new NSSL accuracy measure derived as a deterministic analog to the Cross-Entropy function (a probabilistic measurement).

The OSF Applications Branch MDA/TDA scoring document has been reviewed. The scoring procedure will most likely be re-designed. This scoring procedure, including Web-based documentation and downloadable software, will allow users of the algorithms to develop databases similar to those at NSSL and provide a much larger nationwide database.

Special analysis of the Cincinnati tornado of April 9, 1999 was performed to determine the strengths and weaknesses of the MDA and TDA on those events. Work was collaborated with meteorologists from the OSF Training Branch and members of the Wilmington Ohio NWSFO.

b) Planned efforts

Near-term future efforts will be focused on the incorporation of the MDA into the next feasible ORPG Build (most likely Build 3.0 in 2001). As time permits, some VDDA development will be undertaken. VDDA work will be facilitated in mid to late 2000 as the first Warning Decision Support System II versions are released, allowing the development of VDDA to occur within the CODE framework.

When VDDA work does continue, it is intended to develop alternate and more robust methods to store and manage the extremely large datasets output by the simulated vortex and least-squares derivative programs.

More cases are expected to be added to the database, either by NSSL, or included from future NWSFO field office local studies. Scores of the 88D-Meso algorithm and brute force methods will be completed next quarter.

c)Problems/Issues

The OSF decision whether to implement MDA into ORPG continues to cause uncertainty in the path of this tasking.

d) Interface with other organizations – none.
e) Activity schedule changes – none.

00.6.4 Technical Facilitation

Continue to work through the process of algorithm transition to the operational WSR-88D system. This also includes development of a Common Operations Development Environment (CODE) and Application Programmer Interfaces (APIs) for a more rapid integration of algorithms into the operational system.

a) Current efforts

Work continues on the development of the CODE infrastructure and display system. In November, Mitretek, a partner in the CODE development, delivered their initial portion of the software to NSSL. NSSL has begun integrating this software into the existing CODE infrastructure. This work is expected to take about 2 months.

The development of all the functionality planned for CODE 1.0 is behind schedule. After several discussions with the OSF, NSSL has moved the scheduled delivery date to April 1st and kept the same functionality. This approach was chosen over delivering something of less functionality but by the original date.

The current state of the system includes utilities to read WSR-88D Level II data from tape, an Application Programmer Interface (API) to access base data products, an API to access several algorithm outputs (gridded Cartesian, points, lines, and polar) and an interactive display for viewing base data and products.

The first draft of the Functional Requirements for CODE was developed and is available at:

http://www.nssl.noaa.gov/~johnson/CODE/requirements.html

b) Planned efforts

The development of the CODE infrastructure will continue with a focus on integrating the Mitretek software, completing the implementation of ORPG product functionality and enhancing the display functionality.

c) Problems/Issues – none.

d) Interface with other organizations

We will continue to coordinate this activity with the NWS/Office of Systems Development, and Mitretek.

e) Activity schedule changes

A more feature-rich version of CODE 1.0 will be available by April 1, 2000 than could be available in December, 1999.

00.6.6 Rapid Update

Develop software that produces algorithm output after each tilt, thus providing immediate information to the users.

a) Current efforts

Work on this tasking for FY 00 has not yet started.

b) Planned efforts

Rapid update testing and development is expected to begin again in the 2nd quarter of FY00. Plans include testing and enhancement of the rapid update software and real-time testing during the FY-00 convective season.

c) Problems/Issues

Personnel assignment to this task will be a troublesome issue this quarter. As has happened in the past, several projects, including rapid update need to be delegated in a timeline fashion among the scientists available. Because other funding agencies, including the OSF, work on a calendar year, rather than a fiscal year, and funding from these agencies is not yet finalized, timelines are not yet fully developed.

d) Interface with other organizations - none.
e) Activity Schedule Changes – none.

00.6.7 Cell and Area Tracking

Integration of the Storm Cell Identification and Tracking (SCIT), the Correlation Tracking (CT) and Scale Separation (SS) algorithms into a single multi-scale precipitation tracking and forecast package.

a) Current efforts

NSSL has continued the effort of benchmark testing between MIT/LL's and NSSL's SS/CT implementation. Results continue to show moderate differences between the two implementations. This quarter NSSL's version of SS/CT was modified to ingest the full 160x160 pixel grid of data provided by MIT/LL. The SS/CT software was then run again using the full grids, and comparisons between output from the NSSL version and MIT/LL version were performed. The comparison scores are nearly the same as those derived using the 125 x125 pixel subset grid.

b) Planned efforts

Work during the 2nd quarter will include examination of the advection scheme used by MIT/LL, to be sure that NSSL is performing this process in the same manner. Additionally, NSSL will examine the motion vector fields produced by both NSSL's and MIT/LL's versions of SS/CT.

c) Problems/Issues

Discrepancies between the implementation of the two versions of the SS/CT continue to be elusive. NSSL will continue to track down these differences. If problems are not readily resolvable through teleconferencing and email, NSSL personnel will travel to MIT/LL to discuss the remaining problems.

d) Interface with other organizations – none.
e) Activity schedule changes – none.

00.6.8 Composite Products

Develop high resolution radar layer products that are rapidly updated.

a) Current efforts

Preliminary discussions among NSSL, Mitre, and NCAR have taken place on how to approach this tasking. The first goal is to examine which applicable three dimensional conical to Cartesian transformation to apply, followed by testing of bright band, AP, and clutter filter removal. Finally, prototype operational products and display concepts will be examined.

b) Planned efforts

The main goal for this quarter will be to have the gridding transformation in place and tested.

c) Problems/Issues – none.
d) Interface with other organizations – none.
e) Activity schedule changes – none.

00.6.11 Volume Coverage Patterns

Develop and implement Volume Coverage Patterns (VCPs) relevant to the goals of the AWR PDTs.

a) Current efforts

No work was done on this tasking during the first quarter.

b) Planned efforts

Data collection using the new VCPs will continue during periods of weather that coincide with the availability of the OSF testbed WSR-88D (KCRI).

c) Problems/Issues – none.
d) Interface with other organizations – none.
e) Activity schedule changes – none.

00.6.12 Product Implementation

Explore and define implementation paths within the aviation community systems that are best for NEXRAD PDT products.

a) Current efforts

Efforts this quarter continued to examine a solution to the mapping problems with the demonstration system at the FAA Tech Center. By the holiday break this issue was unresolved.

b) Planned efforts

Coordination with FAA Tech Center personnel will resume during the 2nd quarter. In addition, contacts will be made at the AMS Annual meeting in Long Beach to discuss product issues.

c) Problems/Issues – none.
d) Interface with other organizations – none.
e) Activity schedule changes – none.

00.6.14 Multi-radar Composites

Develop a vision for FAA use of high resolution, rapid update, composite products which are produced from the integration of multiple WSR-88Ds.

a) Current efforts

Work on this tasking has not started. It is expected to being during the 2nd quarter.

b) Planned efforts

Contacts will be established this quarter to begin the definition of a multi-88D composite vision suitable for submission to ARW-100 and the WARP program office. Somewhat in parallel with task 00.6.8, an example demonstration case covering the FT Worth ARTCC will be constructed using the available 88Ds that have Archive II capability.

c) Problems/Issues – none.
d) Interface with other organizations – none.
e) Activity schedule changes – none.